

SECTION 10400

FIXED SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies all fixed signage as indicated on the Design Documents and specified herein. The work of this section includes, but is not limited to, the fabrication and installation of the following:
 1. Station Identification and Wayfinding signs as indicated - porcelain enamel on steel
 2. Maps - Line, RTL, Neighborhood, Bus Neighborhood- porcelain enamel on steel
 3. Historic Interpretive Murals or Art Panels - porcelain enamel on steel
 4. Regulatory, Informational signage - Aluminum
 5. Vinyl signs shall furnished and installed by the contractor
 6. Sign frames and mounting accessories as indicated and required
- B. Custom software to be used by the MBTA Wayfinding Team (WT) for generating all sign content as digital graphic files. No other method of creating graphic files or content is permitted.
- C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 1. Section 05500 - MISCELLANEOUS METALS
 2. Section 09900 - PAINTING
 3. Section 10100 - DISPLAY CASES
 4. Section 10401 - METAL SIGN FRAMES
 5. Section 10426 - TACTILE /BRAILLE SIGNAGE
 6. Section 16000 - ELECTRICAL - "Exit" signs; and "Variable Message Signs"
- D. Transportation: Deliver all signs and related elements, including frames and mounting hardware, to the job site.
- E. Temporary: Provide fabrication, erection, and removal of any and all temporary safety barricades, temporary holding, retaining or storage structures necessary as described herein.
- F. Permits: Obtain permits required by Authority Having Jurisdiction for installation of signs and frames.

1.2 SUBMITTALS

- A. Pre-Construction Wayfinding Meeting: Designer of Record, Contractor, and signage/frame sub (same source for porcelain enamel signage and framing to ensure quality) required to meet with MBTA WT, and MBTA PM and Resident Engineer. The purpose of the meeting is:
 1. To assure there are no misunderstandings concerning the quality and technical requirements of the contract, features of the work, assignment of any "Hold Points" or "Notification Points".
 2. Include discussion of submittals and their sequencing, MBTA WT's requested sign samples with files provided by MBTA WT, and project schedules.
 3. Acceptance criteria, including workmanship and documentation to be submitted attesting to the achievement of the quality and technical requirements.
 4. Include identification of primary and secondary reviewers of submittals, and document management as noted in 1.2.B.
- B. All submittals shall be provided to both the Designer of Record and the MBTA WT for review, must include a dated transmittal form. Disposition and documentation management will be provided through E-builder. Once Designer of Record has performed initial review and recommendation of signage-related construction submittals, Designer of Record shall forward MBTA WT for final review. MBTA is primary reviewer on sign graphics and sign samples. MBTA WT shall submit review to Designer of Record, who will submit to contractor through e-builder.
- C. The contractor shall request digital graphic signage files from MBTA WT. These files are for placement in construction drawings and for final fabrication (once final field measurements have been received for porcelain enamel), including for porcelain enamel, tactile braille, and aluminum signage. See 1.3 for information on Supplied Graphics.
- D. Product Data: Manufacturer's product data, any limitations and recommendations for each material used, installation instructions, and manufacturer's certification (stating that materials comply with requirements) shall be provided for the Designer of Record and MBTA WT's review and acceptance. The contractor shall also provide to MBTA WT the name of sign, art, and mural manufacturer, as well as Fabricator must provide written documentation of their capabilities/specs to the MBTA to show resolution output capability of equipment - line screens (LPI). Warranty, and cleaning and maintenance instructions, and material certifications as outlined in section 1.5 Quality Assurance shall be provided with Product Data at the beginning of construction.

E. Sign Samples: Sample Submittals are in addition to quantities shown in sign schedule. They are record project samples to be kept on file at the MBTA WT's office.

1. Samples: To be provided at the beginning of construction to the MBTA WT within 30 business days from the MBTA WT's submittal of digital graphic files. All samples and proofs must be produced by the fabricator and submitted to the MBTA WT by the contractor for final acceptance. For each physical sign and color sample requested, contractor is to provide three copies. The contractor, Designer of Record, and MBTA WT shall retain these approved control samples for their records.
2. Sample Types to be submitted:
 - a. Paper Proofs: For art and mural panels (if indicated), provide full size paper proofs based on digital graphic files provided by the MBTA WT. These are to come directly from the porcelain enamel fabricator.
 - b. 4 in. x 6 in. Color Samples: Each color shall be provided on all signage substrates specified. Once these are accepted by MBTA WT, MBTA WT's sign sample fabrication can commence.
 - c. Sign Sample: For porcelain enamel signs, art panels, maps, and murals, provide 15in. x 15in. sample with flanges with slots on all four sides of the sample (area of sign determined by MBTA WT and digital graphic file provided at Pre-Construction Wayfinding Meeting - see 1.2A). For aluminum signs, MBTA WT will select sign samples and provide request at Pre-Construction meeting. Samples and proofs will be resubmitted until they meet quality standards as outlined in this spec.
3. Provide samples and proofs to the Designer of Record and MBTA WT at no extra charge.
4. Acceptance is required from the Designer of Record and MBTA WT for all samples and proofs prior to final signage production.
5. Mock-ups: If required, provide a full-size mock-up in place of each type of sign, for locations as determined by the MBTA WT, to verify selections made under sample submittals and to demonstrate aesthetic effects and quality of materials and execution. Build mock-ups to comply with the specified requirements, using materials indicated for final unit of Work.
 - a. If the Designer of Record and MBTA WT determine mock-ups do not comply with requirements, provide new corrected sign(s) until mockups are accepted.
 - b. Acceptance mock-ups may become part of the completed work if undisturbed at time of Contract Substantial Completion.

F. Shop Drawings:

1. Submit shop drawings for fabrication and installation of each sign assembly. This includes, but is not limited to; associated sign panel drawings, plans and elevations, sign content elevations, and large-

scale details of each sign frame and sign panel showing all required mounting holes, slots, clips, flanges, and other integral fastener components and accessory items. See 10401 for requirements for Sign Frame Shop drawings. Provide date stamped digital copies of shop drawings for action by the Designer of Record and MBTA WT through e-builder.

2. Sign Field Measurement Schedules shall be included in Sign shop Drawings:

- a. New Frame Construction: Submit complete sign schedule for each sign. Use same designations as indicated on the Design Documents. For signs scheduled to fit into existing frames, field verify dimensions of existing frames, noting clear openings and sign panel sizes in the sign schedule. The Sign Subcontractor to notify the contractor, Designer of Record, and MBTA WT, in writing, of any size variances from the construction documents so that adjustments can be made to the final sign fabrication files.
- b. Reuse of Existing Sign Frames: For reuse of existing sign frames at existing stations, verify rough opening of all dimensions and provide dimensions to MBTA WT. Advise the MBTA WT of any discrepancies between design size and field-verified size. Final graphic export files will be based on verified sizes.

3. Fabrication of signs cannot commence until sign shop drawings and samples are accepted by Designer of Record and MBTA WT, after sign frames are fabricated, and until full-scale digital .eps files for each sign using final field measurements have been provided by MBTA WT.

G. Signage Submittal Process Summarized with schedule:

PROJECT TITLE: MBTA CONSTRUCTION SIGNAGE SCHEDULE														
PROJECT No. :														
TASK No.	10400 SPEC REFERENCE	TASK DESCRIPTION	YEAR =>											
			MONTH =>		30	30	30	30	30	30	30	30	30	
1	1.2.A	PRE-CONSTRUCTION MEETING with Contractor, frame and signage subs (C), MBTA (T), Designer of Record (D)												
2	1.2.C, 1.2.E, 1.3.A	T: SIGN FILE FOR SHOP DRAWINGS and SAMPLES: T Provides PNG sign graphic files, sign section sample graphics for Porcelain Enamel (PE) and aluminum. Full sign sample graphics for tactile braille.												
3	See 10401	C: PE Frame Shop Drawing SUBMITTAL												
4	See 10401	D: REVIEW Frame Shop Drawings (T Secondary Reviewer)												
5	1.2.E	C: Sign Sample SUBMITTALS: PE, Aluminum, & Tactile Braille												
6	1.2.E	D and T: REVIEW PE, Aluminum, & Tactile Braille Sign Samples (D is Secondary Reviewer).												
7	1.2.F	C: Sign Shop Drawing SUBMITTALS: PE, Aluminum, & Tactile Braille												
8	1.2.F	D and T: REVIEW PE, Aluminum, & Tactile Braille Sign Shop Drawings. (D is Secondary Reviewer).												
9	1.2.F	C: From fabricated PE frames and provides field frame measurements to MBTA												
10	1.2.F	T : Provides Final PE sign graphic files from frame measurements												
11		C: Complete Signage Fabrication												
12		C: Install Signage at Station												
13		D and T: Final Inspection												

 CONTRACTOR RESPONSIBILITY
 MBTA RESPONSIBILITY
 DESIGNER RESPONSIBILITY

1.3 SUPPLIED GRAPHICS

- A. Digital Graphics files: The MBTA WT will prepare and supply all digital sign content to the contractor (see 1.2.C).
 - 1. Elevation drawings of all signs at $\frac{1}{2}'' = 1'$ scale will be provided in raster format for contractor use in preparing shop drawings.
 - 2. Full size sign layouts will be provided in vector format for direct fabrication from digital files.
 - 3. The contractor is responsible for verifying that each sign frame and sign panel is coordinated with the dimensions and content of supplied digital sign files, and for fabricating and installing all signs based on the MBTA WT's supplied graphic layouts of signs, maps, historic interpretive (mural) panels and associated panels.
- B. Formats: Digital files are provided in vector format (.EPS) for use in final fabrication of signs, and in raster format (.PNG) at $\frac{1}{2}'' = 1'$ scale for insertion in to shop drawings (Sign layouts pasted from contract drawings should not be used). Vector graphics do not contain editable fonts. Any typographic editing must be done by the MBTA WT and returned to the contractor.

C. Colors: Match all spot colors using the Pantone Matching System (PMS) or as per file designation in the digital files and in compliance with the standard colors as identified in the MBTA Signage Guidelines. Color samples, PMS color swatches, and proofs are to be provided to the MBTA WT at no extra charge. Standard PMS Colors by Line:

Line	PMS Color
Blue Line	293 C
Green Line	348 C
Orange Line	152 C
Red Line	485 C
Silver Line	430 C
Commuter Rail (purple)	249 C
Amtrak (brand color)	302 C
Bus (Yellow)	1235 C
Commuter Boat	3135 C

D. Mural and Art Panels: The MBTA WT will supply final digital artwork for the mural or art panels to the contractor. The contractor shall be responsible for the fabrication of the artwork, adhering to industry standards of quality and procedures. When one image spans several panels, either a larger sized porcelain panel will be required or margins shall be minimized to reduce white seams.

1. Resolution of final sign output by fabricator must be in vector format (not raster format) with a minimum resolution of 150- 300 LPI. Final output shall match EPS digital files for accurate layout, smoothness of contours and letter forms, and evenness of colors.

1.4 PERFORMANCE REQUIREMENTS

1. Design Criteria: Design, fabricate, and install sign items to withstand normal exposure to weather, temperature variation, wind loads and building movement; provide units resistant to vandalism and theft.
2. Field Measurements: Check actual locations of construction - to which metal fabrications must fit - by accurate field measurements before fabrication; show recorded measurements on final shop drawings.
3. The drawings indicate minimum dimensions and thicknesses for components. Where performance requirements necessitate thickness of material to be increased or additional reinforcing to be added such revisions shall be made without changing the visible profiles of in-lay elements. Where changes cannot be made without changing visible profiles they shall be made only with acceptance by the MBTA WT.
4. Thermal Movements: Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in engineering, fabricating, and installing signs to prevent buckling, opening of joints, over stressing of components and connections, and

other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

a. Temperature Change (Range): 0 - 180 deg F ambient, material surfaces.

5. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 QUALITY ASSURANCE

- A. MBTA Reference Standards: Comply with the MBTA Signage Guidelines V 03.2015.
- B. Reference Standards: The work shall conform to the codes and standards of the following regulatory Agencies and Authorities as further cited herein:
 - 1. ADAAG: Americans with Disabilities Act Accessibility Guidelines
 - 2. ANSI: American National Standards Institute.
 - 3. ASTM: American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 as published in "Compilation of ASTM Standards in Building Codes".
 - 4. MAAB: Massachusetts Architectural Access Board.
 - 5. PEI: Porcelain Enamel Institute, Inc., 1900 L Street N.W., Washington, DC, 20036 - "Specifications for Architectural Porcelain Enamel," PEI-1001 (S-100); and "Standard Tests for Special Properties and Classifications."
 - 6. Structural Code:
 - a. Mass Building Code
 - b. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals
- C. Source: Provide Single-Source Responsibility for the work specified in 10400 and 10401 to control coordination and installation of Frames and Fixed Signage. Inform the MBTA WT of single-source supplier at pre-construction meeting.
- D. Accessibility: The ADAAG and the MAAB regulations are pertinent to the design and installation of items covered under the work of this Section. When guidelines conflict, the guideline giving greater access shall be applicable.
- E. Signage and Frame Coordinator Qualifications: The approved signage and frame coordinator for the manufacturing, delivery, and installation of porcelain enamel shall have a minimum of 5 years of successful experience with porcelain enamel signage and frame work, and shall have a reputation for doing satisfactory work on time and shall have recently successfully

completed similar work.. Installation of sign frames specified in this Section shall be performed by the fabricator.

- F. Welding Standards: Comply with applicable provisions of the American Welding Society AWS D1.1 "Structural Welding Code".
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- G. Coating Applicator Qualifications: must be experienced in successfully applying specified coatings of the type indicated to specified materials, and equipped with the following:
 - 1. Application equipment required to apply a uniform coating as recommended by the coatings manufacturer.
- H. Engineering and structural analysis for signs and new or reused frames, as well as necessary calculations, shall be prepared under the supervision of, and signed and sealed by, the Designer of Record. These calculations shall include gravity, wind, and seismic loading. The internal structure, dimensions and specifications for all items shall be indicated in the Design Drawings, and contractor shall indicate these in the Contractor's shop drawings. The Designer of Record shall engineer signs to a proper level to withstand abuses of their environment, and contractor is to fabricate the signs accordingly.
- I. Coordination: The work in this section shall be completely coordinated with the work of other sections. Verify dimensions and work of other trades that adjoin materials of this section before the installation of items herein specified. Cooperate with such trades to assure the steady progress of all work under this contract.
- J. Project Meetings: The signage contractor and related subcontractors shall be required to attend project meetings at the project site when required by the Designer of Record and MBTA WT.
- K. Certification: Submit manufacturer's certification that materials furnished comply with requirements specified (See section 1.2.D.)
- L. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of each sign installed to the MBTA, including precautions for use of cleaning materials and solvents for paint removal, which could damage surfaces. (See section 1.2.D.)
- M. Warranty:
 - 1. Submit a written manufacturer's warranty for MBTA acceptance, signed by the manufacturer, agreeing to repair or replace panels that fail during the specified warranty period. (See section 1.2.D). Failures include, but are not limited to, the following:
 - a. Coating degradation.
 - b. Chipping, chalking, fogging or discoloration.

- c. Fading.
- d. Structural failure.
- e. Delamination of applied graphics.
- f. Delaminating or degradation of applied anti-graffiti coatings.

2. Warranty Period:
 - a. Porcelain Steel Enamel - 10 years
 - b. Aluminum - 7 years
 - c. Vinyl - 7 years
3. The manufacturer's warranty is in addition to, and not a limitation of, other rights the MBTA may have under the contract documents.

N. Sub-Contractor Approval: Sign sub-contractor and Metal Sign Frames fabricators need to be submitted and approved through the Capital Delivery's sub-contractor approval process prior to starting work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store work under this section in a manner to prevent the cracking or stress of components, and to prevent mechanical damage or damage from the elements.
 1. Porcelain Enamel Signs: Store units at building site, under cover. Place units on minimum 4 in. high wood blocking. Do not use non-ventilating plastic or canvas shelters that could create humidity chambers. If package becomes wet, remove carton and crating immediately. Provide 1/4 in. spaces between stacked units to promote air circulation.
- B. Deliver work under this section to site in ample time to avoid delay in job progress and at such times as to permit proper coordination of the various parts.
- C. Installation of this work shall be scheduled to occur near time of Contract Substantial Completion.
- D. Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's written handling instructions for unloading components subject to damage. Inspect sign components for damage on delivery.
 1. Do not install damaged sign components.
 2. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is approved by MBTA; otherwise, remove and replace damaged sign components.

1.7 PROJECT CONDITIONS

- A. Inspection of Site: The Contractor shall visit the site of the proposed work and become fully acquainted with existing conditions, and to become fully informed as to the facilities involved and the difficulties and restrictions

attending the performance of the contract, prior to submitting a price quotation.

B. Substrates: Proceed with work of this section only when substrate construction and penetration work have been completed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Porcelain Enamel on Steel Signs:

1. Acceptable Porcelain Enamel Sign Manufacturers: Provide products of one of the following manufacturers or approved equal if they meet the requirements of these specifications:
 - a. Winsor Fireform Porcelain, Inc., Tumwater, WA
 - b. Cherokee Porcelain Enamel Corp., Knoxville, TN
 - c. KVO Industries, Inc., Santa Rosa, CA

2. Metal Preparation/Cleaning:

- a. All panels shall be degreased by immersion in an approved degreasing fluid. The panels shall then be rinsed in a heated water bath.
 - b. After the first rinse, panels shall be immersed in a caustic solution sufficient to provide an "etched" surface capable of good porcelain adherence. The panels shall then be rinsed.
 - c. After the third rinse, the chemical action shall be neutralized in a soda ash solution then dried rapidly.

3. Porcelain Enameling:

- a. A porcelain enamel ground coat shall be applied to all areas of each unit, including backside and flanges, by spraying methods recognized by the Porcelain Enamel Institute. At least one additional separately fired cover-coating shall be applied to the face side and flanges of each unit. For corrosion protection and flatness, one additional coating shall be applied to the backside of each panel.
 - b. Apply digitally supplied sign content graphics by silkscreen process; each color shall be fired separately and shall be uniform and even.
 - c. Use MBTA digital graphic files for all content graphics. Do not alter MBTA digital graphic files

4. Finish

and Background Color Control

- a. Color to match approved samples based on MBTA standard colors.
 - b. Continuity of coating: Visual inspection of each unit shall reveal no visible breaks, gas bubbles, scumming, hairlines, stress lines or surface defects in the cover coat.

- c. Check color at each application of enamel with a Hunter Lab D-25 P.C. color difference meter. Produce colors within the limits established during processing of submittals.
- d. The color and finish shall match a color sample previously submitted to and approved by the MBTA WT (see section 1.2.E).
- 5. Ground
and Covercoat Thickness
 - a. Ground and covercoat thickness shall be applied in accordance with PEI recommendations to a thickness range between 0.004 to 0.020", as required by the manufacturer to suit the intended use.
- 6. Firing
a. Panels shall be fired in a continuous furnace (not a batch-type furnace) at a temperature between 1450 - 1600 degrees Fahrenheit to fuse the porcelain enamel to the metal, expel any volatile matter, and ensure color uniformity.
- b. After firing, every panel is submitted to a visual inspection for color consistency against the control panel as approved by the MBTA.
- 7. Glasses
a. Glasses used in the screening process shall be acid resistant and opaque. The glasses shall be corrosion proof, UV proof, wind proof, and vandal resistant. All screen glass must be milled to a 400 mesh particle size or smaller.

B. Aluminum Signs

- 1. Acceptable Aluminum Sign Manufacturers: Provide products from manufacturers if they meet the requirements of the specifications following.
- 2. Aluminum Grade: Alloy 6063-T5 aluminum sheet. Thicknesses as indicated on the sign schedule
 - a. Surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner. Increase metal thickness or reinforce with concealed stiffeners or backing materials as required to produce surfaces without distortion, buckles, warp, or other surface deformations.
 - b. Unframed Single Sheet Panels: Provide unframed single sheet sign panels with edges mechanically and smoothly finished. The thickness of the aluminum sheeting shall be as shown on the plans or in these specifications.
 - c. Aluminum panels shall be free of buckles, warps, dents, cockles, burrs, and any other defects resulting from fabrication processes.
 - d. All possible fabrication including shearing, cutting and punching of holes shall be completed prior to pretreatment of the sheeting.

3. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
4. Continuously weld joints and seams unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.
5. Provide concealed sealing of joints to exclude water and provide corrosion protection, exclude sealing of joints where drainage of moisture will be inhibited - do not seal weep holes. Seal joints with specified sealers. For exposed sealers, provide color to match finish. Provide joint sealers tested for adhesion and compatibility with specified materials and finishes.
6. Mounting Method: Provide members with pins of length shown; for installation, weld to base plates or mechanically fasten where shown unless otherwise indicated. Provide turned pins and other anchorage provisions to resist vandalism and theft.
7. Silk screening imaging: Screen-printed graphics shall be produced directly from full-sized digital vector files, provided to the contractor as final approved graphics. Graphic files shall utilize digitally-prepared screens and shall be printed in accordance with accepted industry standards. No hand-cut screens will be accepted. All screen-printing shall be executed in such a manner that all edges and corners of letterforms are true and clean. Letterforms, color areas, or lines with rounded positive or negative corners, built-up edges, bleeding, spattering, etc. will not be accepted. All inks shall be applied evenly without pinholes, scratches, orange peeling, etc. All silk screening processes shall be accepted by the MBTA prior to fabrication.
8. Finishes:
 - a. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
 - a. The front and back surfaces of all aluminum panels shall be cleaned, deoxidized, and coated with a light, tightly adherent chromate conversion coating free of any powdery residue.
 - b. Shop finish individual components prior to mechanical assembly.
 - c. Color to match approved samples based on MBTA standard colors.
 - d. Shop Painting of Panel Faces:
 - 1) Abrasive brush blasting preparation (SSPC-SP7) to a 100-mesh sandpaper texture.
 - 2) Finish Coats: Provide intermediate and finish coats of "Imron Elite" polyurethane enamel or approved equal to achieve the colors and matte finish selected by the MBTA.
9. Anti-graffiti coating
 - a. For signs scheduled to receive anti-graffiti coating, provide a high-durability, "permanent type" quality, matte finish, non-yellowing, and suitable for painted aluminum surfaces, as manufactured by one of the following companies, or approved equal:
 - 1) Monopole, Monochem Permashield Premium

- 2) Dumond CPU 647 Graffiti Barrier Coat
 - 3) Adsil Microguard AD00
- b. Apply anti-graffiti coatings in strict accordance with manufacturer's instructions
- c. Warranty: 10 years

C. Vinyl Graphics

1. Acceptable Vinyl Graphics Sign Manufacturers: Provide products of one of the following manufacturers or approved equal if they meet the requirements of these specifications:
 - a. Design Communications, Ltd, Boston, MA
 - b. Eastern Sign Industries, Inc., Irvington, NJ
 - c. Signal Sign Co., Livingston, NJ
 - d. Signs + Decal Corp., Brooklyn, NY
 - e. Spectrum Signs Inc., Farmingdale, NY
2. Products
 - a. For maps, vinyl graphics products shall be produced with 3M IJ180mC-10 print wrap film and 3M 8991 anti-graffiti vinyl overlay, or approved equal meeting the following requirements:
 - 1) Thickness: Maximum 0.003 inch
 - 2) Service Temperature: -50°F to +200°F
 - 3) Vinyl Wrap Film Surface Finish: Luster
 - 4) Anti-Graffiti Vinyl Overlay : Gloss
 - 5) Vinyl wrap film shall be opaque or transparent. Anti-graffiti vinyl overlay shall be transparent.
 - 6) Overlay film to have UV protection properties
 - b. For signs, vinyl graphics products shall be produced with 3M 7725 Scotchcal ElectricCut Graphic film and 3M 8520 vinyl matte overlay, or approved equal meeting the following requirements:
 - 1) Thickness: Maximum 0.05 inch
 - 2) Service Temperature: -40°F to +225°F
 - 3) Vinyl Surface Finish: Glossy
 - 4) Anti-Graffiti Vinyl Overlay : Matte
 - 5) Vinyl film shall be opaque. Anti-graffiti vinyl overlay shall be transparent.
 - 6) Overlay film to have UV protection properties

D. Hardware and Frames

1. Supply sign frames and hardware as indicated on the drawings.
2. Structural steel materials, details and workmanship shall conform to the specifications of the latest edition of the A.I.S.C. Specifications for the Design, Fabrication, and Erection of Structural Steel Buildings. ASTM standards:
 - a. Extruded Bars and Shapes: ASTM B 221 (ASTM B 221M), 6063-T6.
 - b. Plate and Sheet: ASTM B 209 (ASTM B 209M), 6061-T6.

- c. Die and Hand Forging: ASTM B 247 (ASTM B 247M), 6061-T6.
- d. Castings: ASTM B 26/B 26M, A356-T6.
- 3. Anchors and Inserts: Use non-ferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. High strength bolts other than anchor bolts, nuts and washers shall conform to ASTM-A325. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
- 4. Tamper resistant fasteners to be stainless steel, 3/8 in. dia. button head Phillips socket pinhead.
- 5. Threaded studs shall be low carbon mild steel with a minimum yield strength of 50,000 PSI.
- 6. All hardware shall be as indicated on drawings: 316 stainless steel, or galvanized per ASTM-A153 requirements.
- 7. Where mechanical fasteners and hardware are required, they shall be of adequate thickness, length and construction to properly secure the sign unit. Any visible portion of any mounting device shall be finished to match adjacent sign surface, unless otherwise specified.
- 8. Non-metallic Washers: Provide rigid neoprene separators between fasteners and non-compatible materials being joined.
- 9. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AS specifications, and as required for color match, strength, and compatibility in the fabricated items.
- 10. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, complying with DOD- P-21035 or SSPC-Paint 20.
- 11. Backing Materials: ½ in. cement board backing - Hardibacker 500 Board or equal, as indicated on the drawings for all signs greater than 18 in. depth.

E. Adhesives:

- 1. Where adhesive mounting techniques are specified, the Contractor shall use adhesives specifically designed for compatibility with the base materials and the desired adhesive strength. All adhesives shall be tested on site. All adhesives shall be indicated in the shop drawings.
- 2. Surfaces on which signage is to be installed using adhesive shall be free of grease, oil, or any other residue.
- 3. Foam tape shall be 1/32 in. thick, high-density open cell double coated polyurethane foam tape for applications indicated as manufactured by the 3M Co. or approved equal.
- 4. Very high bond (VHB) tape shall be double coated acrylic foam tape.

F. Sealant:

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1. For joints indicated in the drawings, provide silicone sealant that meets or exceeds the industry specifications TT-S-230C Class A, ASTM C 920, Class 50, Type S, Grade NS as manufactured by one of the following companies, or approved equal:
 - a. Tremco, Spectrem 1
 - b. Pecora, 864NST
2. Install in strict accordance with manufacturer's instructions.
3. Surface Preparation: prepare joints in accordance with ASTM C 1193 and manufacturer's instructions. For good adhesion, the joint interface must be sound, clean and dry. Clean joint surfaces to remove dirt, dust, oils, wax, paints, and other contamination capable of affecting primer and sealant bond.
4. Joint-Sealant Backing:
 - a. General: provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - b. Elastomeric Tubing Sealant Backings: neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
 - c. Bond-Breaker Tape: polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surface at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.
5. Color: match to frame color as closely as possible - use dark sealant with dark-colored frames and light sealant with light-colored (or galvanized) frames. Submit color selection for approval to MBTA WT before applying sealant.

2.2 FABRICATION

A. Porcelain Enamel Signs:

1. ASTM A424. Porcelain sign panels shall be #16 gauge prime vitreous enameling steel finished with non-fading class A or AA acid resisting Architectural porcelain enamel in color specified, fused to the metal at temperatures between 1450 F to 1600 F. Porcelain enamel sign panels shall be of the best commercial quality and their forms shall be flat, straight, and true. Finish shall be non-reflective matte. Base metal shall receive a ground coat on all surfaces and successive face coats as required on the front and on all flanges. Silkscreened color shall be applied to face surface only. Exercise extreme care in all handling and stacking of porcelain work to avoid chipping. Graphics shall be of high resolution as per specifications.

2. Fabricate from pan-formed porcelain enameled steel plate with flat-flanged edges. All forming shall be mechanical and done in advance of welding.
3. Fabricator must be able to produce a Porcelain Enamel panel that is a minimum length of 96 inches.
4. Precisely form work to sizes, shapes, and profiles indicated on approved shop drawings. Fabricate work with uniform joints that are not visible. Work to be truly straight, plumb, level and square with smooth flat surfaces and sharp corners
5. Location all sign panel joints must be determined and coordinated with MBTA WT in the shop drawing phase to ensure no joints run through text or symbols.
6. Joints between the porcelain enamel panel and the frame shall be $\frac{1}{4}$ in and 3/8 in maximum based on a standard frame detail.
7. All welds shall be clean, sound and solid, free from defects and gas bubbles, and ground and sanded smooth to 3/16in. to match the 3/16in. radii of the mechanical break. They shall be done using a hand oxyacetylene fusion technique with no additions of foreign metals.
8. All necessary holes and cutouts shall be drilled or punched and welded in advance of enameling, with edges sufficiently ground to hold a porcelain coating.
9. Fabricate laminated sandwich construction, consisting of front sheet of porcelain enameled steel plate, on a 1/2 in. thick cement board, with a layer of galvanized steel backing.
10. Porcelain Enamel panels that are placed next to one another shall be butted up to one another without a gap or sealant.

B. Aluminum Signs

1. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
2. Location of all sign panel joints must be determined and coordinated with MBTA WT in the shop drawing phase to ensure no joints run through text or symbols.
3. Continuously weld joints and seams, unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.
4. Provide concealed sealing of joints to exclude water and provide corrosion protection, exclude sealing of joints where drainage of moisture will be inhibited, and do not seal weep holes. Seal joints with specified sealers, and for exposed sealers, provide color to match finish. Provide joint sealers tested for adhesion and compatibility with specified materials and finishes.
5. Mounting Method: Provide members with pins of length shown for installation weld to base plates or mechanically fasten where shown unless otherwise indicated. Provide turned pins and other anchorage provisions to resist vandalism and theft.

C. Adhered Vinyl Graphics

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1. Coordinate dimensions for vinyl graphics with exact supporting panel.
2. Vinyl graphics to wrap all four return legs of backer panel.
 - a. Where new backer panels are to be provided, vinyl graphics shall be installed in the shop.
 - b. Where backer panels are existing, vinyl graphics can be done in the field. Extreme caution shall be taken to minimized exposed edges.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed, and notify the Contractor, Designer of Record, and MBTA WT in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.
- B. Notification Point: The Designer of Record and MBTA WT will be given 72-hour notice to perform field inspection at the start of installation of signage. If work does not meet project requirements, contractor must remove and replace deficient work. A Non-Conformance Report shall be completed for non-conforming work.
- C. Design Team and MBTA WT will perform punch lists to ensure signs are installed as per contract drawings and shop drawings.

3.2 INSTALLATION/APPLICATION/ERECTION

- A. All locations where signs, map, and murals are to be installed within new frames or retrofitted to existing frames must be field measured by contractor. This must be documented and sent to the MBTA WT prior to final digital graphic submittal and fabrication of signage.
- B. Strictly comply with approved shop drawings and manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- C. Install work plumb, level, and in true plane and alignment. Provide signs and graphics where shown or scheduled using mounting methods indicated.
- D. Protect adjacent or adjoining surfaces and work from damage during installation in this section.

- E. Work shall be designed and anchored so that work will not be distorted nor the fasteners overstressed from expansion and contraction of metal or other materials as applicable.
- F. Any signs removed during construction and not replaced in the same shift will be replaced with a temporary sign

3.3 EXISTING PORCELAIN ENAMEL ARTWORK AND SIGN REMOVAL, REFURBISHMENT AND REINSTALLATION

- A. General: Carefully remove and protect existing porcelain enamel artwork that is designated to be removed and reinstalled. Transport existing artwork panels to shop. Refurbish and touch-up artwork panels as required and reinstall at locations indicated.
- B. Stabilization: Stabilize existing porcelain enamel artwork panels to re-establish weather resistance and structural integrity, while maintaining the existing form of each item. Stop the progress of deterioration and corrosion by removing deteriorated coatings and corrosion and reapplying coatings. Repair items where stabilization is not sufficient to stop progress of deterioration. Repair items and retain as much original material as possible.
- C. Remove Deteriorated Coatings: Use mechanical methods, including scraping, wire brushing, and sanding. Use manual methods, including hand power tools.
- D. Remove Corrosion: Remove and stabilize existing deteriorating corrosion. Use mechanical methods, including scraping, wire brushing, and sanding. Use manual methods, including hand-powered tools.
- E. Reapply Protective Coatings: Reapply protective coatings to properly prepared metals.
- F. Repair Items: Match existing materials and features and repair existing work to the greatest extent possible, retaining as much original material as possible to complete the repair.
- G. Repair Method: Unless otherwise indicated, repair existing porcelain enamel artwork panels by patching, piecing-in, splicing, or otherwise reinforcing metals with new metal to match existing.

3.4 TOLERANCES

- A. The following installed tolerances are allowable variations from locations and dimensions indicated by the contract document and shall not be added to allowable tolerances indicated for other work:
 1. Allowable Variation from True Plumb, Level and Line: Plus or minus 1/32 inch from true position for signage smaller than 24 by 24

inches in size; plus or minus 1/16 inch from true position for signage 24 by 24 inches in size and larger.

2. Allowable Variation from True Plane of Adjacent Surfaces: Plus or minus 1/16 inch.

3.5 CLEANING AND PROTECTION

- A. Adjust work to present the best possible appearance. Touch-up damaged finishes and eliminate any evidence of repair. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully repaired or cleaned.
- B. Provide temporary protection to ensure work is delivered without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.
- C. Manufacturer shall provide MBTA WT and MBTA Engineering and Maintenance's Transit Facilities Maintenance Department with information on cleaning and maintenance recommendations for all signs (see section 1.2.D).
- D. Names, stamps and decals of manufacturers, installers or maintainers of signs shall not be visible in the finished work.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

- A. Porcelain enamel and aluminum signage will be measured per each complete in place, including all preparation, accessories and incidentals.

4.2 PAYMENT

- A. Payment for porcelain enamel and aluminum signage will be made at the Contract unit price for the quantities as specified above.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
1042.004	PORCELAIN ENAMEL SIGNS	SF
1042.002	ALUMINUM SIGNS	SF

END OF SECTION